



## **NASA STTR 2008 Phase I Solicitation**

### **T4 Innovative Sensors, Detectors and Instruments for Science Applications**

This topic solicits innovative sensors, detectors and instruments that support the research in Earth and its environment, the solar system, and the universe through observations from space. To assure that our Nation maintains leadership in this endeavor, we are committed to excellence in scientific investigation, in the development and operation of space systems, and in the advancement of essential technologies.

## **Subtopics**

### **T4.01 Lidar, Radar and Coherent Fiber Budnle Arrays**

**Lead Center: GSFC**

As part of its mission, NASA needs advanced remote sensing measurements to improve the scientific understanding of the Earth, its responses to natural and human-induced changes, and to improve model predictions of climate, weather, and natural hazards. By using improved technologies in terrestrial, airborne, and spaceborne instruments, NASA seeks to better observe, analyze, and model the Earth system to aid in the scientific understanding and the possible consequences for life on Earth.

This STTR solicitation is to help provide advanced remote sensing technologies to enable future measurements. Components are sought that demonstrate a capability that is scalable to space or can be mounted on a relevant platform (Unmanned Aircraft Systems (UAS) or aircraft). New approaches, instruments, and components are sought that will

- Enable new Earth Science measurements;
- Enhance an existing measurement capability by significantly improving the performance (spatial/temporal resolution, accuracy, range of regard); and/or
- Substantially reduce the resources (cost, mass, volume, or power) required to attain the same measurement capability.

#### **Lidar Remote Sensing Instruments and Components**

Lidar instruments and components are required to furnish remote sensing measurements for future Earth Science missions. NASA particularly needs advanced components for direct-detection lidar, that can be used on new UAV platforms available to NASA, on the ground as test beds, and eventually in space. Important aspects for components are electro-optic performance, mass, power efficiency and lifetimes. Key components for direct detection lidar (particularly efficient lasers and sensitive detectors) are solicited that enable or support the following Earth Science measurements:

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- Profiling of cloud and aerosol backscatter, with emphasis on multiple beam systems to provide horizontal coverage;
  - Wind measurements (using direct-detection techniques);
  - Remote measurements of carbon-based trace gases (CO<sub>2</sub>, CH<sub>4</sub>, and CO) for total column measurements from aircraft and spacecraft operating to nadir using the Earth's surface as a target, as well as for profiling measurements from the ground using atmospheric backscatter. These systems need tunable, narrow linewidth lasers and sensitive detectors that operate in the 1.5 micron, 1.6 micron and 3.2-3.6 micron bands.

### **Radar Remote Sensing Instruments and Components**

Active microwave remote sensing instruments are required for future Earth Science missions with initial concept development and science measurements on aircraft and UASs. New systems, approaches, and technologies are sought that will enable or significantly enhance the capability for: 1) tropospheric wind measurements within precipitation and clouds at X- through W-band, and 2) precipitation and cloud measurements. Systems and approaches will be considered that demonstrate a capability that can be mounted on a relevant platform (UAS or aircraft). Specific technologies include:

- High efficiency solid state power amplifiers (>5W at W-band, >20W at Ka-band and >50W at Ku-band);
- High duty cycle (~10%) power supplies and modulators for high-power Klystrons at Ka and band (~2 kW peak) for high-altitude (65,000 ft) operation.
- Cross track scanning Ka or W-band Doppler radar technologies with high sensitivity for clouds.
- Low sidelobe (better than -30 dB), high power scanning phased array antennas (X, Ku, Ka or W-band) for high-altitude operation (65,000 ft).
- High speed (output center frequency > 500 MHz), wide bandwidth (>200 MHz) adaptive versatile waveform generator for FM chirp (with amplitude modulation for ultra low sidelobe pulse compression) generation.
- Wind field retrieval processing using dual-beam, dual-look-angle conical scanning radar measurements.

### **Coherent Fiber Bundle Arrays**

Future NASA flight missions are considering passive wavefront and amplitude control (spatial filtering) in astronomical applications such as the search for exo-planets. At least one recent NASA Discovery mission proposal called out the need for a coherent 2-dimensional array of fiber bundles for this application. We are interested in arrays of single-mode coherent fibers, configured as a fiber bundle, that operate in the visible wavelength region and act as an array of both amplitude and wavefront spatial filters for both astronomical and Earth sciences applications. Specific characteristics desired include:

- Coherent fiber bundles should be formed out of single mode fibers to maintain temporal and spatial coherence across the wavelength passband and such that they operate over acceptance angles of up to +/-1.25 degrees.
- 2D arrays comprising from 100 to 2,000 fibers with fiber-to-fiber spacing of from 50 microns up to 500 microns with placement accuracies of < 2.0 microns.
- There should be an array of lenslets on both the input and output side of fiber bundle with each input and output lenslet mapped to a single fiber, with anti-reflection coatings on the fiber ends and on the lenslets.
- Wavelength passbands should encompass the visible range of light but extending down to 0.25 microns and up to 1.0 micron if possible. The fibers should have no cross talk between them and maintain the input polarization state.

